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ANSI/ANS 8.12, Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors

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ANSI/ANS 8.12, Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors

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INTRODUCTION

The ANSI/ANS 8.12 Standard was published in 1978. This standard is applicable with plutonium oxide fuel mixtures outside nuclear reactors, except the assembly of these materials under controlled conditions, such as in critical experiments. In 1978, the standard was issued as ANSI/ANS-8.12-1978 and covered only the application of homogeneous systems. Major revision work was initiated in early 1980 to extend the subcritical limits to heterogeneous systems. That work resulted in the 1987 publication of ANSI/ANS-8.12-1987. Subsequently the standard was extended to 12/31/94 and reaffirmed on 2/17/93. During late 1990s and turn of the 20th century, substantial effort was done by the ANS 8.12 Standard Working Group to reexamine the technical data presented in the standard. Calculations performed showed good agreement with the values published in the standard. This effort culminated in the reaffirmation of the standard on 3/20/2002.

The current membership of the ANS 8.12 Working Group is:

D. Biswas (WSMS)	P. Chou (LLNL)
J. Edge (BNFL, UK)	L. Petrie (ORNL)
S. Huang (LLNL, Chair)	C. Pripp (NRC)
R. Libby (PNL)	N. Lambha (NISYS Corp)
S. Mitake (NUPEC, Japan)	B. Rothleder (DOE/EH)
Y. Shimizu (JNC, Japan)	
D. Erickson (Fluor Federal Services)	
E. Miller (Fluor Federal Services)	

SCOPE

The standard presents subcritical limits for plutonium-uranium mixed oxides containing no more than 30 wt% plutonium combined with uranium containing no more than 0.71 wt% U-235. The standard covers subcritical limits for uniform homogeneous plutonium-uranium mixtures in water. The homogeneous systems include homogeneous aqueous mixtures, dry and damp mixed-oxide powders, and mixtures of the oxides and nitrates of plutonium and natural uranium. The standard also covers subcritical limits for mixed-oxide heterogeneous systems. This standard does not include the details of administrative controls, the design of processes or equipment, the description of instrumentation for process

control or detailed criteria to be met in transporting fissionable materials.

TECHNICAL BASIS

In the development of subcritical limits for this standard, it was the practice of the Working Group to rely heavily on the results of the relevant critical experiments. The preference approach is to compare the calculations with the benchmark experiments whenever they are available. The choice of experiments includes mixed oxides with PuO₂ contents of 30, 14.62, and 7.89 wt% and H/(PU+U) ratios of 47.4, 30.6, and 51.8, respectively. The major technical references are listed below:

Clayton E., Clark H., Magnuson D., Chalmer, J., Walker G., Ketzlach N., Kiyose R., Brown L., Smith D., and Artigas R., "Basis For Subcritical Limits in Proposed Criticality Safety Standard For Mixed Oxides", Nuclear Technology, Vol 35, p 97-111, 1977.

Clayton E., Clark H., Walker G., and Libby R., "Basis For Extending Limits in ANSI standard For Mixed Oxides to Heterogeneous Systems", Nuclear Technology, Vol 75, p225-229, 1986.

FUTURE DEVELOPMENT

The standard is currently in the maintenance mode. The Working Group does meet from time to time and also communicating via e-mail throughout the year to assess current needs and the potential for future revision of the standard.